

# PATENT ABSTRACTS OF JAPAN

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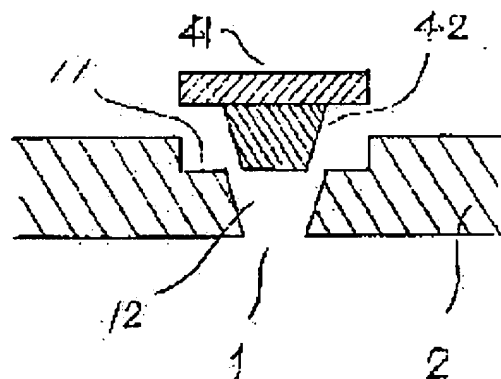
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## (54) NONAQUEOUS ELECTROLYTE SECONDARY BATTERY

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a nonaqueous electrolyte secondary battery equipped with electrolyte immersion hole sealing structure with high reliability by cutting off infiltration of electrolyte solution into a welded part of a battery receptacle and an immersion hole sealing body.

**SOLUTION:** The nonaqueous electrolyte secondary battery is characterized as having a metal battery receptacle 2 and a sealing body for sealing an electrolyte immersion hole 1 equipped with the receptacle, and having the sealing body composed of the main body 41 of the metal sealing body and a rubber plug 42.



## LEGAL STATUS

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to a nonaqueous electrolyte rechargeable battery.

[0002]

[Description of the Prior Art] As main rechargeable batteries with which current and practical use are presented, there are a lead accumulator, a Ni-Cd battery, a nickel hydride battery, a silver-oxide zinc cell, a nonaqueous cell, etc.

[0003] Lead is used for a lead dioxide and a negative-electrode active material, it uses a dilute sulfuric acid for the electrolytic solution at positive active material, and the lead accumulator has the operating potential of about 2 V. This cell has balance in respect of quality, dependability, and a price, and has spread widely as the object for automobiles, the object for electric rolling stock, an object for uninterruptible power supplies, etc. Moreover, recent years come, the technique of the formation of small sealing progresses, and usefulness is increasing also as various objects for cordless devices.

[0004] Cadmium is used for oxy-nickel hydroxide and a negative-electrode active material, it uses a potassium-hydroxide water solution for the electrolytic solution at positive active material, and a Ni-Cd battery has the operating potential of about 1.2 V. Since the operating temperature limits where internal resistance is small and strong against the possibility of high current discharge, a long cycle life, and overcharge and overdischarge have the descriptions, such as being large, this cell is widely used considering the consumer dexterous way as a core.

[0005] A nickel hydride battery uses a hydrogen storing metal alloy for oxy-nickel hydroxide and a negative-electrode active material, and uses a potassium-hydroxide water solution for the electrolytic solution at positive active material, and operating potential is about 1.2V. It is a high energy consistency and is put in practical use centering on various consumer machines.

[0006] A silver-oxide zinc cell uses zinc for a silver oxide and a negative-electrode active material, and uses a potassium hydroxide for positive active material at the electrolytic solution. a thing large-sized from from [ of being expensive ] while it has high power and a high energy consistency -- the object for space, and deep sea -- although the application as a \*\* is main, the small thing has spread widely as the object for clocks, or an object for calculators.

[0007] The typical thing of a nonaqueous cell is a rechargeable lithium-ion battery, as for this, what used the organic solution for the carbonaceous ingredient which carries out occlusion emission of the Li ion for Li metal multiple oxide which carries out occlusion emission of the Li ion of  $\text{LiCoO}_2$ ,  $\text{LiNiO}_2$ , and  $\text{LiMn}_2\text{O}_4$  grade at a negative-electrode active material at the electrolytic solution is common to positive active material, and it has 3V set operating potential. The application is quickly expanded as an object for consumer from an advantage, like there are not high operating potential, a high energy consistency, and a memory effect.

[0008] The above practical use rechargeable batteries are offered according to an application in forms, such as a square shape, a cylindrical shape, a carbon button form, and a sheet form. Although there are various things in the cell container used for these rechargeable batteries, when it roughly divides, they are the product made of resin, metal, and a product made from a laminate film.

[0009] The rechargeable battery using the cell container made of resin is chosen according to \*\*, such as a class of electrolytic solutions, such as a sulfuric acid and alkali, shock resistance, and thermal resistance, and the purpose-for-spending purpose, although it is common knowledge for example, in the lead accumulator for automobiles and there are polypropylene resin, polyolefin resin, styrene resin, etc. as the quality of the material of the cell container made of resin.

[0010] The rechargeable battery using a metal battery case is also common knowledge by the flat thin square shape cells for cellular phones etc., and, generally the battery case made from iron nickel plating and the battery case made from aluminum are used. And a metal battery case is used as a positive-electrode terminal or a negative-electrode terminal in many cases.

[0011] The thing made from a laminate film joins opening, after containing a generation-of-electrical-energy element to a battery case saccate with the laminate material of a polyethylene sheet and an aluminium sheet, nothing, and this as indicated by JP,9-199099,A. As for this, a future purpose-for-spending expansion is expected as an object for portable devices.

[0012]

[Problem(s) to be Solved by the Invention] By the way, the expectation for the rechargeable lithium-ion battery which has a mass rechargeable battery, division, a high voltage, and a high energy consistency in industrial use, the object for deferment, etc. is growing in recent years. The thing equipped with the metal cell container of current and the rechargeable lithium-ion battery currently used is in use. The rechargeable lithium-ion battery equipped with this metal cell container contains the layered product or eddy rolled object of a positive electrode, a negative electrode, and a separator in said cell container, the electrolytic solution is poured in from the electrolytic-solution inlet subsequently to a cell container prepared, and seals this electrolytic-solution inlet with a sealing object after that, and is manufactured.

[0013] As the sealing approach of the electrolytic-solution inlet of the rechargeable lithium-ion battery equipped with such a metal cell container, the spherical sealing object 4 is inserted in the inlet 1 prepared in the cell container 2, and there is the approach of carrying out ultrasonic welding using the ultrasonic horn 3 as indicated by JP,8-45488,A, for example (refer to drawing 1 ). However, there are a technical problem that the horn of ultrasonic welding must be processed according to the configuration of a cell container, and a problem that the dependability of sealing is not necessarily enough in this approach. In addition, drawing 1 (A) is a mimetic diagram in which drawing 1 (B) shows the condition after sealing before inlet sealing.

[0014] Apart from the above, there is also a method of making a cell container and a sealing object unify by resistance welding. However, there is danger of ignition of the organic electrolytic solution accompanying generating of a spark in a resistance welding method.

[0015] Moreover, as other approaches, using the so-called sealing object 4 of the shape of a coma as shown in drawing 2 (the shape of a truncated cone), it inserts in the electrolytic-solution inlet 1 which prepared this in the cell container 2, and there is also a method of joining both by laser welding. From points, such as workability, although this approach is comparatively common, when the electrolytic solution permeates the clearance between a sealing object and an electrolytic-solution inlet, there is a technical problem that it is easy to generate poor welding in this approach. In addition, drawing 2 (A) is a mimetic diagram in which drawing 2 (B) shows the condition after sealing before inlet sealing. This invention is

offering the nonaqueous electrolyte rechargeable battery which was made in order to solve the above technical problems, and was equipped with the inlet closure structure the sealing dependability of an electrolytic-solution inlet being high.

[0016]

[Means for Solving the Problem] The 1st invention made in order to solve the above-mentioned technical problem is equipped with a metal cell container and the sealing object for sealing the electrolytic-solution inlet prepared in the metal cell container, and a sealing object is a nonaqueous electrolyte rechargeable battery characterized by consisting of a metal sealing object body and a rubber stopper object.

[0017] The 2nd invention is [ both ] a nonaqueous electrolyte rechargeable battery concerning the 1st invention with which a metal cell container and a metal sealing object body are characterized by being a product made from aluminum.

[0018] It is a nonaqueous electrolyte rechargeable battery concerning invention of the 1st or 2 to which the 3rd invention considers as the description that a metal sealing object body is discoid with a diameter [ of 0.3-5mm ], and a thickness of 0.1-3mm.

[0019] A rubber stopper object is the nonaqueous electrolyte rechargeable battery with which a path requires the 4th invention for invention of the 1st, 2, or 3 to which it is characterized by being the truncated-cone form which becomes small toward a metal cell container inside side.

[0020] It is a nonaqueous electrolyte rechargeable battery concerning invention of the 1st, 2, or 4 to which the 5th invention considers as the description that a metal sealing object body has the shape of the shape of an ellipse, and a polygon.

[0021] It is a nonaqueous electrolyte rechargeable battery concerning invention of the 1st, 2, 3 and 4, or 5 characterized by the 6th invention consisting of a crevice into which an electrolytic-solution inlet fits a metal sealing object body, and a pore which fits in a rubber stopper object.

[0022]

[Embodiment of the Invention] This invention is faced that a sealing object closes the electrolytic-solution inlet prepared in the metal cell container, and said purpose is attained by using the sealing object which consists of a sealing object body and a rubber stopper object for the purpose of eliminating poor welding by the electrolytic solution permeating the gap of an inlet and a sealing object. That is, a rubber stopper object blocks the pore of an inlet and poor welding by adhesion of the electrolytic solution is reduced by [ which the electrolytic solution permeates to the weld zone of a cell container and a sealing object body ] carrying out thing prevention.

[0023] In addition, although a cell container consists of lids which plug up the body of a container which contains a plate and the electrolytic solution, and the body of a container, in this invention, it doubled these and has called them the cell container. And if an electrolytic-solution inlet may be prepared in the body of a cell container, as for a certain thing, being prepared in a lid will also be common knowledge. Moreover, as for a rubber stopper object, it is desirable to have nonaqueous electrolyte-proof nature, for example, a fluororubber and EPDM can be used.

[0024] Furthermore, you may be joined with adhesives, and the metal sealing object body and the rubber stopper object may be unified by fitting as shown in drawing 5 . Furthermore, after equipping an inlet with a rubber stopper object first and equipping with a metal sealing object body subsequently, a cell container and a metal sealing object body may be joined. In addition, it is desirable to use the adhesives which have nonaqueous electrolyte-proof nature in adhesion.

[0025]

[Example] Drawing 3 is the mimetic diagram showing one example of this invention, and 1 is the electrolytic-solution inlet formed in the cell container 2 made from aluminum with a thickness of 0.3mm. The metal sealing object body with which 41 consists of a disk made from

aluminum with a thickness [ of 0.2mm ] and a diameter of 1.5mm, and 42 are the plugs made from truncated-cone-like EPDM, and the metal sealing object body 41 and the plug 42 made of rubber are joined to one with acrylic adhesives. 11 is the circle-like crevice formed in the upper part (cell container outside) of an inlet 1, and it is constituted so that it may fit in with the metal sealing object body 41. 12 is the pore constituted so that it might fit in with the rubber stopper object 42, and the path is small toward the cell container inside. The inlet 1 consists of a these circle-like crevice 11 and a pore 12.

[0026] In addition, when fitting of the rubber stopper object 42 is carried out to a pore 12, as for the path of the meaning to the rubber stopper object 42 which prevents that the electrolytic solution permeates through the clearance between both, it is desirable to have the dimension relation pressed fit in a pore 12.

[0027] The sealing object was inserted in the above-mentioned inlet, both were joined by laser welding, and the nonaqueous electrolyte rechargeable battery was obtained. In addition, a cell dimension is 5.2x35x47mm in square shape configuration, and an electrolytic-solution injection rate is about 3g. The same nonaqueous electrolyte rechargeable battery as the above-mentioned example was obtained except having had the sealing object for the inlet shown in drawing 2 for the comparison.

[0028] In addition, what added LiPF<sub>6</sub> to the mixed solvent of ethylene carbonate and diethyl carbonate as the electrolytic solution was used using the thing which made the carbonaceous active material hold to copper foil as a negative electrode using the thing which made LiCoO<sub>2</sub> active material hold to aluminium foil as a positive electrode. however, the compound which makes a subject Li<sub>x</sub>MO<sub>2</sub> (however, M transition metals more than a kind) not as the thing to restrict to this but as positive active material -- independent -- or it is desirable to be able to mix and use two or more sorts and to use especially a kind or two sorts or more of transition metals which consist of Co(es), nickel, and Mn as transition metals M from the height of discharge voltage.

[0029] Moreover, it is also possible to use LiMn<sub>2</sub>O<sub>4</sub> etc. Moreover, a negative electrode is independent in a natural graphite, corks, glassy carbon, graphite, nongraphitizing carbon, pyrolytic carbon, a carbon fiber or a metal lithium, a lithium alloy, the poly acene, etc., or can mix and use two or more sorts. Furthermore, about nonaqueous electrolyte, as solvents other than an ethylene ape fight, trimethyl phosphate, and the fluorination ether, it is independent to the mixed solvent of ethylene carbonate and ethyl methyl carbonate, or the mixed solvent of ethylene carbonate and dimethyl carbonate in propylene carbonate, butylene carbonate, vinylene carbonate, trifluoro propylene carbonate, gamma-butyrolactone, 2-methyl-gamma-butyl lactone, dibutyl carbonate, etc., or two or more sorts can be mixed and used for it.

[0030] As an electrolyte salt as a solute of nonaqueous electrolyte, it is independent in LiClO<sub>4</sub>, LiAsF<sub>6</sub>, LiBF<sub>4</sub>, and LiCF<sub>2</sub>SO<sub>3</sub> grade, or two or more sorts can be mixed and used.

[0031] After carrying out 100-piece \*\*\*\* preparation respectively and leaving the above-mentioned example cell and the example cell of a comparison in a vacuum housing for 24 hours, viewing investigated the liquid spill existence from the sealing section. Consequently, in the example, the liquid spill incidence rate of the example of a comparison was 5% to the liquid spill incidence rate having been zero.

[0032] Compared with the example cell of a comparison, it turns out that the way of an example cell is clearly excellent in the liquid spill-proof engine performance so that clearly from this result. this -- the pore 12 of an inlet -- the rubber stopper object 42 -- liquid -- by being blocked densely, since electrolytic-solution adhesion in the weld zone of the cell container and sealing plug in a production process thru/or osmosis by capillarity were prevented, it is guessed.

[0033] On the other hand, in the case of the example of a comparison, although the sealing plug 4 has fitted into an inlet 1, it is transmitted to few clearances and the electrolytic solution

permeates, and since it reached to the weld zone, poor welding is conjectured to have generated mostly.

[0034] The above-mentioned example is [0035]. [ good / as a sealing object which has the truncated-cone-like sealing object body 41 and the truncated-cone-like rubber stopper object 42 / and good / although a truncated-cone-like rubber stopper object is formed in a disc-like sealing object body / as shown in drawing 4 (A) / as the disc-like sealing object body 41 and a cylindrical rubber stopper object 42 which has the annular projected part of pars intermedia as shown in drawing 4 (B) ] Moreover, although it can also be made into the shape of the shape of the shape of an ellipse (B), and a rectangle (C), and a rhombus (D) etc., without restricting to the discoid shown in (A) of drawing 6 , when it takes into consideration like a welding operator, the shape of discoid or a truncated cone is desirable [ a sealing object body ]. In that case, as for a sealing object body, it is desirable from the point of the dependability of welding that it is 0.1-3mm in the diameter of 0.3-5mm and thickness.

[0036] Moreover, other approaches are not eliminated although being based on laser welding is suitable for junction on a cell container and a sealing object. Furthermore, although it is desirable that a cell container and a sealing object body are the products made from aluminum from points, such as weight efficiency, the thing made from iron nickel plating is also employable.

[0037]

[Effect of the Invention] This invention is faced that a sealing object closes the electrolytic-solution inlet prepared in the metal cell container, and said purpose is attained by using the sealing object which consists of a sealing object body and a rubber stopper object for the purpose of eliminating poor welding by the electrolytic solution permeating the gap of an inlet and a sealing object. That is, a rubber stopper object can block the pore of an inlet and poor welding by adhesion of the electrolytic solution can be reduced by [ which the electrolytic solution permeates to the weld zone of a cell container and a sealing object body ] carrying out thing prevention. The nonaqueous electrolyte rechargeable battery equipped with the electrolytic-solution inlet sealing structure where the sealing dependability of an electrolytic-solution inlet is high, by this can be offered.

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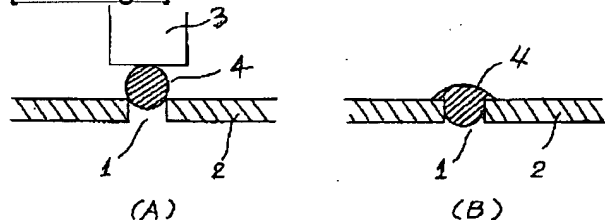
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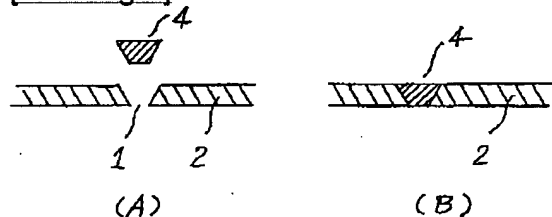
DRAWINGS

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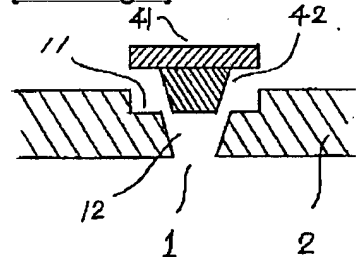
[Drawing 1]



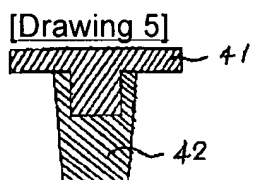
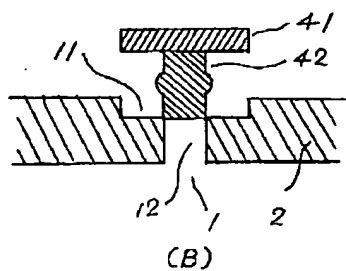
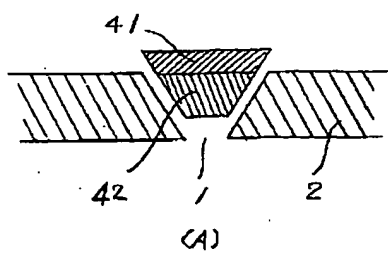
[Drawing 2]



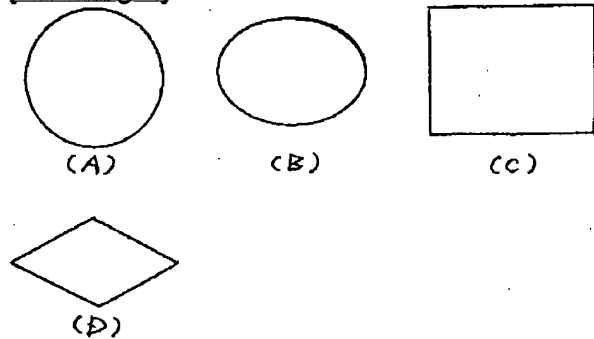
[Drawing 3]



[Drawing 4]



[Drawing 6]



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